UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

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THREE UTAH COAL FIELD STUDIES OUT

H. H. Doelling, UGMS economic geologist and project officer, and R. L. Graham, coal geologist, have finished reports on three coal fields in Utah. These reports are on open file and may be seen at UGMS, University of Utah, Salt Lake City. These coal surveys are supported by federal funds through the Department of Health, Education and Welfare.

In light of projected national fuel shortages and the need for more power in the southwest United States, interest is stimulated in possible large scale development of the Alton coal field in south Utah. Three favorable factors influence development in this area: (1) an abundance of economically recoverable coal of satisfactory quality, (2) availability of underground water to support a steam generating plant and (3) a growing market for power in the southwest.

Approximately 370 square miles of land are contained in the Kaiparowits Plateau coal field in south central Utah. Lands set aside have been acquired both by major companies and small operators.

Alton field reserves total 2.1 billion tons of coal. They extend in a horseshoe pattern for 35 miles, located about midway between Panguitch and Kanab, in the Paunsaugunt Plateau. Some 50,000 tons have been removed. The new interest is confirmed by the fact that nearly 28,000 acres of prime coal lands have been leased.

Exploration activity for coal has given several communities an economic boost. The conventient location of Lake Powell as a source of water for operations makes possible steam-powered electric plants in the area. Developers of the projected power plants have successfully negotiated with the federal government

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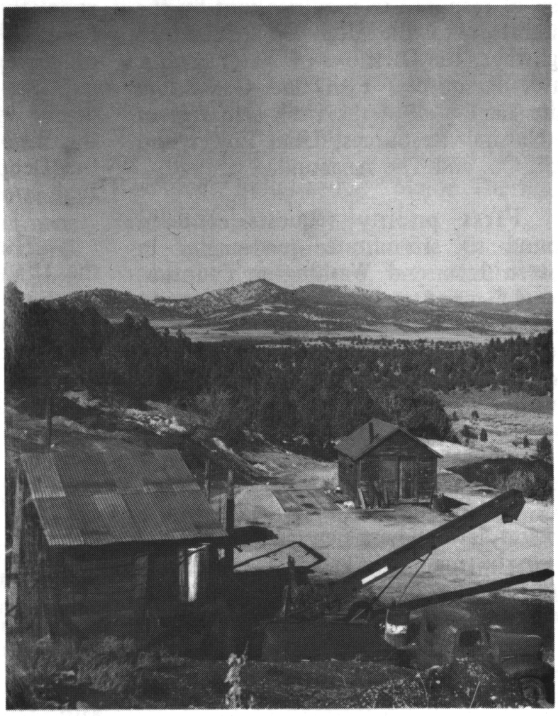

Alton Coal mine, in southeast Utah.

ON ENVIRONMENT

Utah Senator Speaks

Sen. Frank E. Moss, D-Utah, said in Washington that the national interest requires increased production of minerals and fuels coupled with "the protection and the enhancement of our environment."

Moss, who is chairman of the Senate's minerals, materials and fuels subcommittee, was the principal speaker in January at a luncheon of the American Mining Congress.

He said the mining industry should lead the movement to meet the "demands of a vast majority of Americans for an end to pollution of our waters, pollution of our air and the degradation and despoliation of our lands."

GEOTHERMAL STEAM ACT

Federal lands may be opened to the development of plants to produce electric power by harnessing the natural heat energy of the earth, under the Geothermal Steam Act of 1970 signed into law by President Nixon. The legislation authorizes the Interior Department to issue long-term leases to private companies for development of geothermal steam power on public domain lands.

The Interior Department environmental report accompanying the measure said there would be some potential environmental hazards involved because of possible thermal pollution and uncontrolled brine production, but that technology is available to control both sources of pollution so that water quality requirements could be met. The report said development of geothermal energy could help clean up the air, since fuel would not have to be burned to produce electricity.

The Interior Department estimates there are 1,350,000 acres of known geothermal resources areas on public domain in Western States, and it has withdrawn these areas from all forms of mineral entry because of the indicated presence of this resource.

The Pacific Gas and Electric Co. is now producing 84,000 kilowatts of electricity from energy supplied by geothermal steam wells at the Geysers in Sonoma County, California. According to a recent report, PG&E expects to have more than 600 megawatts of generating capacity operating on natural steam sources by the end of 1975.

As early as 1890, houses and greenhouses in Boise, Idaho were heated by steam issuing from the earth. That steam is still flowing today to 200 customers along one avenue in the city.

The town of Klamath Falls, Oregon has used geothermal steam in similar fashion since the 1930's. The steam comes from 500 wells and is so easily accessible that local plumbers make the connections routinely. Five hundred houses, seven schools, an apartment house, several factories and a large technical school outside the town are supplied with heat in this manner.

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for industrial use of water from Lake Powell.

Development of the Vernal coal field dates back to before 1900 when the coal was used by local markets in the Uinta Basin. Production from the Vernal mines has been more than 250,000 tons. Reserve is calculated at 177.2 million short tons with a 50 percent minable portion. The field entirely surrounds the town of Vernal.

The reports on the Alton, Kaiparowits and Vernal coal fields show detail of the location of the fields in relationship to the surrounding area, topography and drainage, vegetation and wildlife, population, industries, transportation factors and climatic conditions. The geologic description and illustrations show stratigraphy, structure, geologic and tectonic history, and correlation with surroundings. Coal deposits are documented by bibliographies, land ownership, analyses, maps, tables and photographs. Quadrangles are mapped, fully described and illustrated.

UGMS Exhibit at IOCC Meeting

"Utah has much to offer," "Great Salt Lake mineral resources are attracting attention across the country," "We're watching the Uintah Basin oil and gas activity with interest," "Progress in tar sand mapping and research in Utah is outstanding," were a few of the statements made to Carlton Stowe, UGMS staff specialist, at the annual meeting of the Interstate Oil Compact Commission in Santa Fe, New Mexico, December 7 and 8, 1970.

The UGMS exhibit of publications, maps and publications lists was a center of attention at the meeting and provoked the above comments.

A report on the work of UGMS in tar sand mapping and research, prepared by H. R. Ritzma, was read by Nace Mefford, chairman of the tar sands subcommittee.

Wallace Yardley, Utah Oil and Gas Commissioner, and Paul Burchell, chief petroleum engineer of the Utah Division of Oil and Gas also attended, as did Delbert Draper, chairman of the Utah Oil and Gas Commission. Draper was elected second vice-president of the Interstate Oil Compact Commission. Newly elected president is Preston Smith, governor of Texas.

State Mapping Committee Meets

The Utah State Mapping Advisory Committee, chaired by W. P. Hewitt, UGMS director and State Geologist, met in November 1970 in Salt Lake City and drew up a list of priorities for mapping. These priorities were determined on the basis of response to inquiries sent by the committee to the Utah Department of Highways, the Divisions of Water Rights, Water Resources, Fish and Game and State Lands, all of the Utah Department of Natural Resources, Utah Power and Light Co. and The Anaconda Co.

First priority requests centered around six 15-minute quadrangles in western Iron and Washington counties. Six 15-minute quadrangles scattered throughout Millard, Box Elder, Iron, Tooele and Carbon counties represented several priority targets. Third order priorities were located principally in Carbon and Emery counties. Each year these requests are added to mapping requests from Federal agencies such as BLM and the Forest Service, and the decision as to where new mapping starts are to be made, in Utah or elsewhere, rests on the number of requests obtained.

The State Mapping Advisory Committee feels that its recommendations have carried weight since the Committee's requests frequently appear on mapping programs designated to start in the following year.

UTAH ASSOCIATION ELECTS

New officers of the Utah Association of Petroleum and Mining Landmen have been elected for 1971.

Robert G. Vernon of Skyline Oil Co. succeeds Don A. Nicols of Getty Oil Co. as president.

UGMS staff specialist Carlton H. Stowe is the new vice president, Jim Baucum of Humble Oil and Refining Co., secretary, and William G. Lasrich, treasurer.

UAPML membership is composed of nearly 100 landmen, lawyers, independent oil, gas and mining brokers, and representatives of operating companies throughout the state.

Deep Creek Dissertation Out

Mineral deposits in the Deep Creek Mountains of western Utah were the subject of a PhD dissertation completed recently at the University of Utah. Kenneth C. Thomson, assistant professor of geology at Southwest Missouri State College at Springfield, received his degree in August 1970. Formal title of the dissertation is "Mineral Deposits of the Deep Creek Mountains, Tooele and Juab counties, Utah."

The Deep Creek Mountains lie on the Utah-Nevada border on the western edge of the great Salt Lake Desert, south from Gold Hill and west from Callao, ghostly towns that are reminders of the era of the Pony Express and the Gold Hill mining boom. Part of the Goshute Reservation lies within this region.

Thomson's detailed magnetic, geochemical and stratigraphic descriptions provide background for detailed information and maps of all of the known claims and mines in the area. The rocks range in age from Precambrian through Permian, chiefly sedimentary and metamorphic, scattered outcrops of Tertiary and Quaternary volcanic flows, and unconsolidated Quaternary sediments.

The Deep Creek area consists of three mining zones, from north to south, Clifton, Willow Springs and Spring Creek. Minerals of principal interest are silver, gold, copper, lead, tungsten, zinc and mercury.

Semiprecious stones to be found in the Deep Creeks are jasper, chalcedony, quartz, petrified wood, chrysocolla, aquamarine, beryl, aventurine and "Ibapahite," a green and red silicified breccia named after the town of Ibapah.

The study by Thomson will be published by UGMS in its Bulletin series. Meantime a copy of the dissertation is available for examination at the University of Utah library.

The Gold Hill area, directly north of Clifton, was studied by H. M. Shatoury. His PhD dissertation was published by UGMS as "Mineralogy of the Gold Hill Mining District, Tooele County, Utah."

USBM Tests
OIL FIELD WATER SAMPLES

UGMS, in cooperation with the U. S. Bureau of Mines, Utah Oil and Gas Conservation Commission, and operating personnel from various oil companies, is undertaking a systematic collection of oil field water samples in Utah. Analysis of samples is being done by the U. S. Bureau of Mines Oil Field Water Research Laboratory in Bartlesville, Oklahoma. Carlton Stowe, UGMS staff specialist, is supervising the sampling.

Oil field waters have been analyzed routinely by oil companies, commercial laboratories and government agencies for many years. Data assembled, mainly concerning degree of salinity and identity of minerals in solution, has had uses in:

1. Designing corrosion control programs in oil fields to prevent or minimize pollution from leaks caused by corrosion.

2. Formulation of special cements used to emplace well casing in saline formations, sealing them from leakage.

3. Solving plugging problems in oil and gas wells where salts are deposited by brines.

4. Designing disposal systems to minimize surface and subsurface pollution of fresh waters by oil field brines.

5. Assisting interpretation of electrical logs which are affected by presence of saline waters in oil field reservoirs.

Samples will be taken from exploratory wells and established fields and producing areas. Special efforts are being made to obtain water samples from deep formations previously unpenetrated and from wildcat wells testing new areas. The Bureau of Mines analyses will also go beyond the usual routine oil field brine analysis and measure the content of iodine, bromine, fluorine, lithium and other less common constituents of the waters sampled.

Large quantities of water are produced in several Utah oil fields. Much of this water is cycled through these fields to maintain pressure and assist in oil production. Minerals contained in oil field waters could possibly be extracted during the cycling process and provide a valuable byproduct to oil production.

Sampling kits are supplied to UGMS by the Bureau of Mines. Each kit contains two plastic quart sample bottles and a small container of concentrated hydrochloric acid. The water sample is obtained by opening a valve at the drilling site or well head system and filling the bottles with brine. The hydrochloric acid is added to one of the bottles, and the samples are sent to the Bureau of Mines research laboratory at Bartlesville.

Information has been assembled on 30 fields throughout Utah with several more being processed and accumulated. Mountain Fuel Supply has responded with samples from Clay Basin field, Daggett County, and Cowboy field, San Juan County. Participating companies are Phillips Petroleum, Continental Oil, Gulf Oil, Pure Oil (Union Oil), Southern Natural Gas, Chevron Oil, Humble Oil and Refining, Tenneco Oil and Shell Oil.

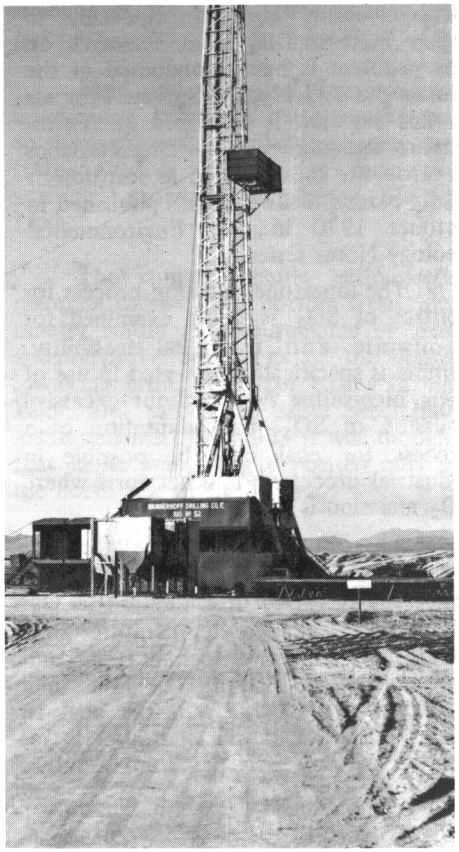
Thermal Springs . . . . . *SOURCE OF UTAH POWER?*

Increasing attention is being directed toward thermal springs as source indicators of geothermal energy for generation of electric power. A statewide reconnaissance has been conducted by J. C. Mundorff, hydrologist, U. S. Geological Survey, on the thermal, chemical and geologic characteristics of the major springs of Utah. His findings are published in newly released Water-Resources Bulletin 13, "Major Thermal Springs of Utah," by UGMS.

Information on the location, chemical characteristics, water discharge, temperature and general geologic setting was obtained on more than 45 thermal springs in Utah. The springs have been of scientific and economic interest for more than a century. The possibilities of producing natural steam depend on the existence of a source of heat and the composition of the bedrock. Thermal discharges with temperatures at or near the boiling point of water invite exploration for geothermal energy. In Utah three such springs occur: Thermo Hot Springs, 16 miles west of Minersville, Beaver County; Abraham Hot Springs, 18 miles north-northwest of Delta; and Roosevelt Hot Springs, 12 miles northeast of Milford.

The bulletin contains descriptions of all of the thermal springs in Utah, 23 figures, three tables and two large scale plates showing locations and chemical constituents. It is available by mail for $3.30 from UGMS, 103 Utah Geological Survey Building, University of Utah, Salt Lake City 84112, or $3.00 at the UGMS office.

PAN AM WILDCAT ACTIVITY



Brinkerhoff Drilling Co. rig No. 2, drilling for Pan American Petroleum in the remote Escalante Desert, southern Utah.

Pan American Petroleum's exploratory well about 30 miles northwest of Cedar City in Iron County is perhaps the most closely watched wildcat underway in Utah. The well is in a remote area known as Table Butte, in the Escalante Desert Basin where the surface area is covered with volcanic rock.

Extensive seismic work in the past two years provides evidence of a "hinge line" which is believed to be the miogeosyncline hinge line separating the Colorado Plateau from the Basin and Range area of western Utah. Pan American has not revealed its planned projected total depth, nor will it release information on drilling progress until a later date. Four water sample kits were recently left with engineers at the well for extracting samples for analysis at the U. S. Bureau of Mines at Bartlesville, Oklahoma.

A PERENNIAL PROBLEM

INDUSTRIAL SO_2

Emission of sulfur dioxide (SO_2) from industrial installations is a major environmental concern, especially in highly industrialized areas. Research on this problem is being conducted at the Illinois State Geological Survey. Progress in this research is described in "Petrographic and mineralogical characteristics of carbonate rocks related to sorption of sulfur oxides in flue gases," published in October 1970 in their Environmental Geology Notes series.

The limestone injection process for control of SO_2 is being examined for economic and technical feasibility. Illinois is specifically interested in use of their high-sulfur coal without excessive emission of SO_2, but adaptation of a process for coal may be possible in industrial processes of other sorts where SO_2 emission is a problem.

The basic procedure for this method of SO_2 control is injection of limestone ($CaCO_3$) or dolomite ($CaCO_3 \cdot MgCO_3$) in a high temperature zone where it is converted to lime (CaO) and carbon dioxide (CO_2). The lime then combines with SO_2 from the coal to form anhydrite ($CaSO_4$), which is removed as solid particles from the flue gases.

Geologists recognize that limestones and dolomites exhibit a wide range of physical and chemical behavior. The object of the Survey's research program is to evaluate samples of all types of limestone and dolomite and to determine the properties or charactistics that influence their reaction rate and SO_2 sorption capacity.

The project has been partly funded by the National Air Pollution Control Administration of the U. S. Department of Health, Education and Welfare.

Four Corners Air Quality Proposal

The Federal Air Pollution Control Administration has proposed that an air quality control region–largest in the country–be established in the Four Corners area. It would embrace 108,000 square miles, with a population of 433,000 persons. Parts of eight Utah counties would be included.

Offshore Oil Wells Offer Example

Strict enforcement of regulations pays off in Long Beach, California, according to the November 1970 *Western Oil Reporter*. The city has been in the oil business since the award of the first tidelands oil contract in 1939, and in that time has never experienced a major oil leak or other oil despoilage.

The latest development in Long Beach is the construction of the Astronaut Islands, named after four astronauts who lost their lives in the nation's space program. They are drilling islands, constructed during 1965 and 1966. Each contains approximately 160,000 tons of granite and 900,000 cubic yards of hydraulically-placed sand fill. The largest rocks weigh five tons apiece. Each island covers about ten acres and cost approximately $2 million not including facilities.

A total of 661 wells have been drilled, of which 489 are producers, four of these flowing and the rest on pump. There are 30 to 40 more to drill.

Every aspect of pollution control has been considered in developing the field. Beautification cost, including trees, shrubs, camouflaged and soundproofed derricks, and sculptural forms, averages $1 million per island.

The oil field, the East Wilmington, helps to support the claim of the Wilmington field to the record daily production of 238,000 barrels, with 130,420 barrels from the Long Beach or East Wilmington unit.

Five companies, Texaco, Humble, Union, Mobil and Shell, formed a new jointly-owned company in 1965 known as THUMS Long Beach Company, operator of the unit.

Steel pipelines, laid in trenches 10 to 12 feet deep and backfilled, transport the oil to the mainland. The lines were constructed and tested at pressures far exceeding any operational pressures. Each welded joint was X-rayed during construction and all flange connections are onshore, none under water. The pipelines are coated and equipped with a cathodic protection system for detection of corrosion.

The City of Long Beach has insisted on the strictest controls. To protect against possible well blowouts, surface pipe is cemented solidly to a minimum depth of 800 feet. Both flowing and pumping wells are equipped with automatic valves to close the well in case of wellhead damage or an oil line break.

Electronic monitoring devices set off alarms in case of release of combustible gases into the atmosphere. Each island has its own fire fighting system and equipment. The Long Beach Fire Department maintains two fireboats in the harbor area which would respond to any emergency. In the event of a major fire, personnel from one of the department's shore stations are available in a matter of minutes.

Each island is equipped with a skimming boom, and the camouflaged derricks serve a purpose besides soundproofing and beautification; they contain oil spray that might be emitted during drilling operations.

Long Beach exercises special caution, because it not only has a responsibility to local residents but also to the citizens of the state to protect the public beaches and waters. The result is the safe and orderly development of natural resources to the mutual benefit of all concerned without hurting animals or plants and without visual or audible pollution.

GRADUATE STUDENT IN EGYPT

H. M. Shatoury, who received his PhD in geology from the University of Utah in 1967, has recently completed a tour of duty with the United Nations Development programme in the assessment of mineral potential of the Aswan region. Most of the one and one-half years were spent working in the southernmost part of the Eastern Desert. He has now returned to the Atomic Energy Establishment of the United Arab Republic.

Shatoury's dissertation was published by UGMS. He is senior author, with J. A. Whelan of the UGMS staff, of "Mineralization in the Gold Hill Mining district, Tooele County, Utah," Bulletin 83 of the UGMS series.

Solution Mining Introduced at Cane Creek

Dissolving minerals underground in water and pumping the solution out of the ground is one way of beating the high cost of mining, according to B. L. Bessinger, general manager of the Potash Division of Texas Gulf Sulfur Company, who spoke to the Salt Lake City section of AIME in November 1970 on the change from machine mining of potash to solution mining at its Cane Creek mine near Moab, Grand County, Utah. Fresh water was introduced to a portion of the mine workings in December, and it is expected that by May 1971 the first brine will be pumped and sent to the evaporation ponds for eventual recovery of potash in the treatment plant. When the process is in full operation it is expected that the annual recovery will be 300,000 tons of potassium chloride.

TGS acquired the Cane Creek site on the Colorado River eight miles southwest of Moab about 1960 and proceeded to drill out the potash beds in the Pennsylvanian Paradox Formation. As the mine workings reached out into the formation it became apparent that the beds had been disturbed by salt tectonics, and were rumpled, thinned out in places and otherwise changed so that the cost of mining was materially increased. Modified procedures produced 400,000 tons of potassium chloride in 1969.

With the mining of potash beds in the Devonian of Saskatchewan in Canada, the market became flooded and the price dropped from $27 per ton in 1962 to $12 in 1969. This turn of events required that the operation be abandoned or a much less costly recovery procedure be installed. Hence the change to solution mining.

The 300 miles of workings in the potash beds expose 2,000 acres of contact surface from which water will dissolve the salt. Solution will continue to increase contact surface. It is expected that the recovered brine will contain 2 parts of sodium chloride to 1 part of potassium chloride and will contain 31.9 percent total salt at 85° F. It will rise only to within 600 feet of the surface because of its density and will be pumped to 400 acres of evaporation ponds lined with heavy plastic. The salt will be mixed to a slurry with brine and piped to the mill. Thickeners will recover the salt and the sodium chloride separated from the potassium chloride by flotation. It is not expected that calcium or magnesium salts will interfere and neither will be recovered. The sodium chloride and other impurities will go to the large tailings ponds where the salt grains cement themselves into a hard mass.

Bessinger did not elaborate on the fate of the 600,000 tons of sodium chloride which will be discarded annually when the plant is in full operation.

A minimum 20-year life is predicted for the mine, based on removal of all pillars by solution and walls adjacent to workings to a depth of 10 feet. It is hoped the formation will be maintained without serious caving and the solution process continued to even greater areal extent.

In view of the continuing oversupply of potash described by the U. S. Bureau of Mines in a recent report it is fortunate for this segment of Utah's economy that TGS shows some success in developing an economical means of removing the mineral.

NORTHWEST UTAH OIL TREND DISCOVERED

Discovery of a new oil trend in the western Uinta basin of Utah has accelerated drilling activity in a three-county area, according to October 1970 *Oil World*. Most exploration wells are contracted for 9,000–13,000-foot depths.

New oil discoveries in the Uinta basin of northeast Utah are responsible for accelerated Rocky Mountain drilling activity. Nineteen drilling operations on 9,000–13,000-foot contracts now are under way in a three-county area.

The play extends from Roosevelt and Bluebell fields in Uintah County, across the new Altamont, Cedar Rim and Sink Draw fields of Duchesne County, into south Wasatch County 20 miles southwest.

Major companies active in the area include Shell Oil Co., Chevron Oil Co., Gulf Oil Co.-U. S. and Texaco Inc. Active independents include Mountain Fuel Supply Co. of Salt Lake City, Utah, and Gas Producing Enterprises (Coastal States Gas Producing Co.) of Corpus Christi, Texas.

Production is concentrated in Tertiary Green River and Wasatch formations.

SALT LAKE SECRETS PROBED

by Harry Suekawa

Several hitherto unreported phenomena in the south arm of Great Salt Lake are under study by UGMS.

Field and analytical data accumulated since 1966 are being synthesized to show physical and chemical characteristics which differ from previously assumed properties attributed to the Lake.

The studies include bathymetric mapping of the Lake bottom from fathometer readings, measurements of areal and vertical fluctuations of the denser low-lying brine in deeper basins of the Lake, and associated halite precipitate measurements.Until 1968 it was thought that halite was being deposited only in the north arm of the Lake.

Also interesting are sediment ridges in some parts of the Lake bottom. These elongate mounds of unconsolidated sediments are believed to be fracture-controlled and still forming as the result of groundwater seepage.

Reports on these studies will present some of the newer physical observations on the Lake and perhaps provide information to help qualify conclusions about equilibrium conditions of the brine caused by the railroad causeway.

Pine View Reservoir

UGMS MONITORS SLIDE AREA

Bruce N. Kaliser, UGMS engineering geologist, continues his monitoring of Pine View Reservoir's slopes in Ogden Canyon. Recent lowering of the reservoir water level exposed the lower slopes for the first time in many years, enabling a close inspection.

Earlier this year the area caused some concern when attention was focused on a potential land slide hazard bordering the reservoir.

The current reservoir slope reconnaissance was conducted by Kaliser, and the area was found to be stable. No evidence of earth movement was observed in the newly revealed lower slopes.

The reservoir area remains under consistent observation by UGMS and monitoring will continue.

SANITARY LANDFILL AT CEDAR CITY

Bruce Kaliser, UGMS engineering geologist, conducted on-site investigation of a proposed sanitary landfill site in Cedar City, Utah. The site was evaluated when the State Division of Environmental Health required approval by the state and county.

Kaliser presented testimony at a hearing conducted by the Iron County Board of Adjustments November 18, 1970 in Cedar City. Lynn Thatcher, State Director of Environmental Health, and Carlton Stowe, UGMS staff specialist, were present.

The purpose of the meeting was to hear complaints and opinions on the site from all interested parties. More than 40 persons were present.

Factors under consideration were precipitation, impermeability of clay, infiltration from floodwaters and irrigation canals, ground-water movement, underground water table movement and static water levels in wells throughout the area. The site is on an alluvial fan where deposits are stratified silts, thin clays, sands and gravels.

Kaliser concluded that the site was satisfactory after his investigation covered hydrologic and geologic factors.

Thatcher commented that Cedar City is not alone with its disposal site problem. Of 158 investigations in Utah, only four have been considered good.

During the week of December 10, 1970, the County Board of Adjustments voted 4 to 1 in favor of zoning the site for use as a sanitary land fill operation.

Summer Field Work In Utah

UGMS *Quarterly Review* publishes information annually in its May issue about geologic field work planned for the ensuing summer. If you contemplate field work in Utah in the summer of 1971, please provide the information requested on the questionnaire which follows page 8 in this issue of the *Quarterly Review*. The map on the back of the questionnaire should be marked to show the area of the field work.

The questionnaire should be mailed to Editorial Office, Utah Geological and Mineralogical Survey, UGS Building, University of Utah, Salt Lake City, Utah 84112, by March 31, 1971.

Great Salt Lake Seismic Data Available

Seismic reflection survey analog data of the Great Salt Lake area are now available from UGMS. Robert B. Smith of the Department of Geological and Geophysical Sciences, University of Utah, obtained continuous profiles totaling approximately 470 miles in a complete seismic survey of the lake conducted in August and September 1969. The survey, financed by a grant from the National Science Foundation, was a cooperative effort by the University of Utah, UGMS, and the University of Wisconsin at Milwaukee.

The seismic instrumentation consisted of a 30 kw Westerbeck generator, a 3,000 psi air compressor, a 10 cubic-inch Bolt air-gun seismic source, a Gifft wet paper graphic recorder, a Timesfax graphic recorder, hydrophone streamers, an EG&G seismic amplifer, Kronhite filter systems, and a four-track, one-quarter inch analog tape recorder. Profiles were obtained with useful penetration of 2,000 to 3,000 feet. Water depths averaged 20 feet.

The seismic data indicate at least three major sedimentary units within the Great Salt Lake basin which were interpreted as follows: (1) a surface unconsolidated layer of mud, clay and salt, (2) a semiconsolidated Tertiary layer and (3) a consolidated Tertiary layer. Basement units were interpreted as Paleozoic and Precambrian rocks. The north end is characterized by a major north-northwest trending sedimentary basin bounded on the east and west by several zones of north trending normal faults and gentle folds. Near the surface, Glauber's salt layers show salt flowage structures and diapir folds. The south end appears to be a deeper continuation of the northern Tertiary sedimentary basin with a regional eastward dip, but it appears to lack the dominance of salt flowage features present to the north. A Tertiary-Paleozoic contact interpreted from the data in the north end of the lake appears to be about 2,000 feet below the lake surface. Pre-Tertiary topography was identified.

The seismic data provide structural knowledge of the subsurface geology of the Great Salt Lake basin. It is of particular interest to exploration companies interested in the mineral and petroleum resources of the Great Salt Lake area.

The seismic reflection survey is indexed by navigational lines. Copies of the analog data can be reproduced from sepia prints for all or any part of the survey. The data can also be inspected at the office of UGMS. Arrangement for use of digital magnetic tapes of the data must be made with Dr. Smith. The University of Utah retains all proprietary rights on reproduction and publication of these data.

USGS-UTAH WATER REPORTS OUT

Utah's Department of Natural Resources, in cooperation with U. S. Geological Survey, has recently published the results of two studies of water in Utah.

"Hydrologic reconnaissance of the Sink Valley area, Tooele and Box Elder counties, Utah," by Don Price and E. L. Bolke, hydrologists with USGS, Technical Publication No. 26, discusses a 330 square-mile area in northwest Utah, a dry sparsely populated area with an average annual rainfall of 6 to 12 inches. The potential evaporation, 58 inches per year, limits available water to ground-water, poor in quality because of the high sodium chloride content.

The small quantity and poor quality of the water limit major development of water resources in Sink Valley and adjacent area.

"Ground-water conditions in southern Utah Valley and Goshen Valley, Utah," by R. M. Cordova, hydrologist with USGS, Technical Publication No. 28, discusses water conditions around Utah Lake.

It appears that withdrawal and recharge of the ground-water in the southern Utah Valley is approximately in equilibrium; discharge exceeds recharge in Goshen Valley, with resulting recession of the water table.

Copies of these publications are not available at UGMS, but information about them may be obtained from the Utah State Department of Natural Resources, Division of Water Rights, 442 State Capitol Bldg., Salt Lake City, Utah 84114.

UGMS VESSEL HEADED FOR DRY DOCK

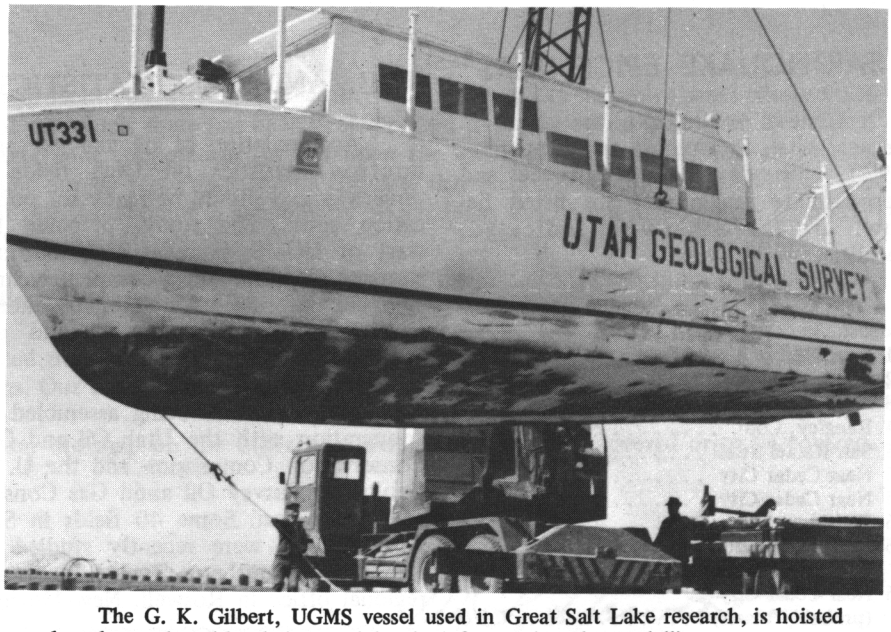
Most of the Great Salt Lake Navy was hoisted out of Great Salt Lake in December and headed for repair and renovation, according to W. M. Katzenberger, chief of operation and maintenance of equipment of UGMS Great Salt Lake Project.

The G. K. Gilbert showed signs of wear and corrosion acquired during performance of its last job, the drilling and coring of 48 locations in the north arm of the Lake. The craft was grounded many times in effort to reach localities close to shore. The 26-inch draft prevented drilling of five nearshore localities, inside the 6.5-mile limit on the north shore where the water is too shallow for the boat to enter.

Analysis of the core samples, collected in a cooperative project with USGS, is being conducted by J. H. Goodwin of the University of Utah Department of Geological and Geophysical Sciences.

Katzenberger said that spring should see the Gilbert emerge with an extensive face lifting. The cabin roof line will be lowered two feet and the life line stanchions removed. The pilot house will be relocated in a forward position on the port side. These alterations will allow the Gilbert to go through the culverts in the Southern Pacific causeway which divides the north arm from the south arm of the Lake.

A request has been submitted to Southern Pacific for a wooden lining and an entrance chute to be installed in a culvert to facilitate movement of boats through the causeway.



The G. K. Gilbert, UGMS vessel used in Great Salt Lake research, is hoisted aboard a truck and headed toward dry dock for repair and remodelling.

New Society, New Officers
Geological Groups Merge

The president of the Utah Geological Association is Howard Ritzma of UGMS. Edward R. Keller, Mountain Fuel Supply is vice president, Ronald Willden, Vanguard Exploration Co., is secretary, and James W. Hood, USGS, is treasurer. Leslie W. Camp of Kennecott is program chairman.

The association was formed recently by merger of the Utah Geological Society and the Intermountain Association of Geologists.

Oil Production Up In Duchesne County

Duchesne County in Utah's western Uinta Basin continues to be one of the busiest petroleum exploration areas in the Rockies. Winter weather has slowed action, but drilling rigs punching down 12,000-foot wells hum around the clock, and the basin's waxy crude oil continues to flow in record quantity to refineries in the Salt Lake City area.

As a gauge of the prolific production in the western basin area, the one-well Altamont Field flowed 41,171 barrels of oil in August 1970 for an average of 1,328 barrels per day. Two wells drilled by Mountain Fuel Supply in the Cedar Rim-Sink Draw area 12 miles west of Duchesne flowed at unusually high rates during production tests. MFS No. 2 Sink Draw produced 634 barrels in 19 hours, and No. 3 Cedar Rim flowed 2,020 barrels in 21 hours, averaging nearly 100 barrels per hour. Both wells produce from Wasatch Formation sands.

Two miles south of the Altamont well, Shell is drilling No. 1-11-84 Brotherson, an extension well in the field. Scheduled as a Cretaceous test to 18,000 feet, this well will be the first to penetrate the entire thick Tertiary section in the western basin and will at total depth set a new drilling depth record for Utah.

GSL CORPORATION OPERATING

In a brief ceremony in December 1970, near the shores of Great Salt Lake, Great Salt Lake Minerals and Chemicals Corp. dedicated its new plant and 20 square-mile pond facility. Governor Rampton was the principal speaker and more than 250 state and national officials attended the occasion.

Highlight of the formal ceremony was the cutting of a ribbon by a railroad hopper car loaded with potassium sulfate fertilizer. The ceremony opened the first multi-product commercial operation to extract salts from the Lake's mineral-rich brines and refine them into saleable compounds such as potassium sulfate, sodium sulfate, sodium chloride and magnesium chloride.

The minerals and chemicals find use in agriculture as fertilizer and cattle feed supplements and in the process industries for the manufacture of detergents, paper and magnesium metal, and for road de-icing.

Pilot studies are underway by Lithium Corporation of America, a fellow subsidiary with GSL Minerals and Chemicals Corp. of Gulf Resources and Chemical Corp., to evaluate installation of commercial facilities for recovery of lithium and bromine.

Governor Rampton, in his address, stated that the corporation has paid $1,330,000 in state taxes to date, and that after production is underway it will pay an annual sum of $500,000 in taxes. $35,000,000 have been expended in establishing the operation.

EARTHQUAKE EPICENTERS

General earthquake epicenters in or near Utah for August and September 1970, with dates of occurrence and approximate magnitude, are listed below. Unless otherwise indicated, localities are in Utah.

		Magnitude
August		
1	Southeast of Castle Dale	2.6
2	South of Levan	<2.0
3	North of Green River	2.5
4	Rangley, Colo.	2.0
5	San Rafael Swell	<2.0
5	Near Cedar City	<2.0
5	Near Cedar City	<2.0
6	Southeast Idaho	3.1
6	East of Randolph, Utah in Wyoming	2.5
6	Near Cedar City (probably blasts)	<2.0
6	Near Cedar City (probably blasts)	<2.0
6	East central Nevada	3.1
7	East central Nevada	3.2
7	East central Nevada	<2.0
8	South of Hanksville	No mag
8	South of Hanksville	No mag
9	Near Promontory	2.2
12	Near Nephi	<2.0
13	East of Logan, 65 miles in Wyoming	2.0
15	Near Monroe	2.3
15	South of Manti	2.0
15	South of Salina	2.4
15	South of Sunnyside	No mag
16	East central Nevada	3.3
18	South of Sunnyside	2.0
18	Near Ephraim	2.2
19	South of Sunnyside	<2.0
19	Southwest Wyoming	No mag
19	East central Nevada	3.0
20	Near Antimony	2.2
20	Southwest Wyoming	2.4
20	East central Nevada	3.2
20	North of Mexican Hat	2.7
23	South of Sunnyside	<2.0
23	South of Salina	No mag
24	Near Randolph	<2.0
26	Near Lakeside	2.4
26	Near Monroe	2.1
26	Near Boulder	2.5
28	Near Orange Cliffs	No mag
31	Near Antimony (felt)	2.4
31	Near Antimony (felt)	3.1
31	Green River Desert	No mag
September		
1	Near Kamas	2.5
1	Near Pine Valley	3.5
1	Southern Utah-Nevada border	3.0
1	Southern Wyoming	2.5
3	Southern Idaho	2.7
3	Southern Wyoming	2.5
7	Near Bingham Canyon	<2.0
9	Southern Wyoming	2.5
9	Near Coalville	No mag
10	Near Park City	<2.0
11	Near Park City	<2.0
11	Bear Lake	<2.0
11	Near Salt Lake City	<2.0
15	East of Randolph in Wyoming	No mag
15	East of Randolph in Wyoming	No mag
16	Near Woodside	2.4
16	Southern Utah-Nevada border	3.0
16	Northern Arizona	3.8
17	Near Huntsville	2.1
17	Near Green River	2.5
17	East of Randolph in Wyoming	2.4
17	Southern Utah-Nevada border	2.7
17	East of Moab	No mag
18	Eastern Nevada	3.3
19	Near Coal Cliffs	No mag
19	Near Green River	No mag
20	Near Salina	<2.0
20	Near Green River	No mag
20	Near Magna	<2.0
21	Southern Wyoming	3.7
21	East of Randolph in Wyoming	No mag
22	Near Green River	2.2
22	Southwest Wyoming	3.5
22	Near Randolph	2.5
22	Southwest Colorado	3.5
23	Near Castle Rock	2.1
24	Orange Cliffs	<2.0
24	South of Sunnyside	<2.0
24	Southeast Nevada	2.8
25	San Rafael Swell	<2.0
25	Near Emery	No mag
25	Near Fish Lake	2.4
25	70 miles east of Logan in Wyoming	2.2
27	San Rafael Swell	No mag
27	San Rafael Swell	<2.0
27	San Rafael Swell	2.5
28	San Rafael Swell	<2.0
29	Near Randolph	2.1
30	Northeast of Hanna	2.4
30	Coal Cliffs	2.4

These earthquakes were recorded by the University of Utah seismograph stations under the direction of Kenneth L. Cook. All locations and magnitudes are preliminary determinations; the final determinations will be printed in the University of Utah Seismological Bulletin, issued quarterly.

OIL AND GAS STATISTICS

Accumulation of oil and gas production statistics on Utah fields is underway and should be ready for publication soon. The study, prepared by staff of UGMS, includes field outlines showing all wells and a complete yearly total of oil, gas and water produced. Characteristics of crude oil and gas analyses will be shown.

The report is being assembled in cooperation with the Utah Oil and Gas Conservation Commission and the U. S. Geological Survey Oil andd Gas Conservation Division. Some 40 fields in San Juan County were recently studied at the USGS Southern Rocky Mountain regional office in Roswell, New Mexico.

Symposium Report:

GSL SALT ECONOMY

Interesting facts on the salt economy of Great Salt Lake are brought out in a comprehensive report by A. J. Eardley, Department of Geological and Geophysical Sciences, University of Utah. Reprints of the study, published in the Third Symposium on Salt by the Northern Ohio Geological Society, Inc., Cleveland, Ohio, are available from UGMS, University of Utah. A limited supply is available for 25 cents over the counter, 50 cents by mail.

Chemical analyses for Dr. Eardley's report were obtained in cooperation with UGMS. The report describes the sources of the salt in Great Salt Lake, documents reserves of the individual ions, and analyzes the natural gains and losses. The effect of commercial extraction on the apparent balances is weighed.

The lake contains about 4.7 billion tons of salt, another 2 billion tons are in recycling regimen, and 2 billion tons in the salt crusts and underclays. Streams and springs are bringing 4.7 million tons of salt to the lake each year.

Utahn at USBM

Dr. Thomas A. Henrie, U. S. Bureau of Mines scientist and research administrator, has been appointed to the newly established bureau position of Deputy Director for Mineral Resources and Environmental Development, the Department of Interior has announced.

Since 1966 Dr. Henrie has been research director of the bureau's Metallurgy Research Center at Reno. In his new post, he will admisister all research, resource and environmental operations in the bureau. The new position embraces two formerly distinct bureau functions: (1) research on the conservation and use of minerals and (2) studies of mineral economics, including collection of statistics on production, consumption and related factors. The positions were combined during a bureau reorganization last April.

Born in Utah, he attended Brigham Young University where he received a BS degree in chemistry in 1952. He received his PhD in metallurgy from the University of Utah in 1955.

MINERAL PRODUCTION IN UTAH BY COUNTY, 1969–1970

by Carlton H. Stowe, Mineral Information Specialist, UGMS

Mineral production in Utah for 1969 was valued at $543.5 million, a record high for the state, and preliminary annual figures for 1970 show an increase of $86.2 million over 1969 for a new all-time high of $629.6 million. (U. S. Bureau of Mines).

In 1969 increases were recorded in all three commodity groups, metals, mineral fuels and nonmentals; metals had the greatest gain. The total value of the 11 commodities in the metals group was 37 percent greater than that of 1968. Silver, uranium and vanadium decreased in total value; all others increased.

Production of mineral fuels increased 6 percent in total value in 1969. Asphalt and related bitumens, carbon dioxide, coal and petroleum showed gains. The value of marketed natural gas, LP gases and natural gasoline declined slightly. Production of LP gases and natural gas increased modestly.

1970 total value of 12 commodities in the metals group increased $83.8 million (22 percent). Depressed gold prices lowered the value of gold to $2.9 million (16 percent); minor losses were recorded in two commodities and increases occurred in the other metals.

In the mineral fuels group, decreases in value were recorded in three of the six commodities, but the total value of all commodities in the group was $9.8 million greater (9 percent).

The value of production in the nonmentals group showed a loss of $7.5 million, a decrease of 14 percent from 1969. Clay, fluorspar, gypsum, magnesium chloride, phosphate rock and sodium sulfate recorded increases in total value, but the remaining 10 nonmetallic commodities showed either decreases or no change in values.

Although volume of petroleum produced during 1969 was 1 percent less than that of the previous year, value of production increased 4 percent because of a slight increase in wellhead prices. Marketed natural gas increased 1 percent from the 46.2 billion cubic feet marketed in 1968. Preliminary figures for 1970 show a small increase in petroleum output over 1969. Marketed natural gas production declined 6 percent.

In 1969, 142 wells were completed, 87 development and 55 wildcat. Footage drilled totaled 637,826 ft. Of the 142 wells, 54 were oil, 16 gas and 72 were dry, a success ratio of 49 percent. Two of the 55 wildcat wells, both in Duchesne County, were successful. Mountain Fuel Supply completed No. 2 Cedar Rim, flowing 888 barrels of oil from Wasatch (Tertiary) from a depth of 8580 to 8670 ft. The second discovery was by Gulf Oil in the Cottonwood Wash area.

Active rotaries ranged from 7 to 19, averaged 12. Oil industry expenditures amounted to $42 million, down from the 1968 figure of $55 million. Early drilling activity records in 1970 show decreases to a total of 96 wells, including 42 wildcats.

During 1970, two significant oil discoveries were made, one by Shell Oil Co. in the Altamont area of Duchesne County, flowing 1,100 barrels of oil per day from Green River (Tertiary), and the other by Mountain Fuel Supply at its Sink Draw field discovery well, completed for 925 barrels of oil. As a result of these two discoveries the Uintah-Ouray Indian Agency lease sale in September was one of the most successful sales in several years; a total of nearly $2 million was bid in bonuses for 17,000 acres. Elsewhere, several oil companies acquired lease blocks in south central Utah, creating one of the biggest lease-plays in the state.

1969 copper output increased 30 percent with a 48 percent rise in total value. The average selling price was 47.5 cents per pound compared with 41.8 cents for the prior year. Kennecott Copper Corp. at Bingham was again the largest single producer in the United States. Nineteen mines in 10 Utah counties contributed to the total copper production. Kennecott is constructing a pilot leaching plant on the Verona dump at Bingham to investigate further possible commercial recovery of uranium from the area now leached for the contained copper. A 400 ton-per-day oxygen plant at Garfield, completed in 1969, is supplying oxygen to the Kennecott smelter to enrich the air blast for direct smelting of copper concentrate and precipitate in the converters. That plant is operated by Linde Division, Union Carbide Corp.

Six open pit mines in Iron County, owned by CF&I Steel Corp., increased iron ore production 9 percent and total value 11 percent. Value of lead output increased 3 percent because of higher selling price per pound; total production, however, declined 9 percent. Production of silver was up 16 percent, but because of a slightly lower selling price per ounce, the total value was 3 percent less than in 1968. Twenty-two mines in 10 counties record silver production. Fewer uranium mines were in operation in Utah compared with 134 operations during 1968. Production was 33 percent less, and total value declined 48 percent. Production of zinc, increasing 5 percent, was reported from 18 mines in nine counties. Value was up 14 percent, partly because of higher average selling price (14.6 cents).

Coal from 21 properties in six counties increased 8 percent in output and 18 percent in total value. As in past years, the combined production from Carbon and Emery counties contributed most of Utah's coal, 98.1 percent. The U. S. Department of the Interior authorized Resources Co. to use ultimately 102,000 acre-feet of water from Lake Powell annually for a steam-electric power generating plant to be constructed in Utah 14 miles northwest of Page, Arizona. The water service contract will be in effect for 40 years with provisions for renewal. Coal for the plant is to be mined in the Kaiparowits Plateau field.

United Park City Mines, The Anaconda Company and American Smelting and Refining Co. agreed to terms of a 25-year lease of mining properties in the Park City district. Exploration and mine development operations will cost at least $2.5 million during the first two years of the lease period and not less than $250,000 each year thereafter.

Construction of the chemical project site by National Lead Co. on the southwest shore of Great Salt Lake is on schedule and should be completed in late 1971. Principal production will be magnesium metal with lesser quantities of chlorine, lithium, calcium sulfate and potassium sulfate. Great Salt Lake Minerals and Chemicals Corp. dedicated its 20 square-mile solar evaporating pond complex and processing plants late in 1970. The firm produced salts for harvest and concentrated brines for future pond and plant operations. The plants will process potassium sulfate and sodium sulfate.

Also in 1970, Utah Power and Light Co. announced plans for construction of a thermoelectric power plant in Huntington Canyon, Carbon County, in 1971. The first 45 megawatt unit is expected to be completed in 1974.

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Federal and state mineral statistics related to leasing and royalties are maintained on a fiscal year basis. The following information is therefore dated to show the time period involved. Monies collected by federal and state agencies for leases, rentals and royalties on minerals produced in Utah for the fiscal year ending June 30, 1969 amounted to $15.8 million. The total received by the state, including the federal allocation to the state, was $5.6 million. Mineral production and values by county for 1969 are listed below. For a comparison with 1968 figures, the reader is invited to check the UGMS *Quarterly Review* for February 1970, v. 4, No. 1, p. 7.

Information for this report was derived mainly from the U. S. Bureau of Mines report, "Mineral Industry Surveys: the Mineral Industry of Utah, 1969"; additional information was released to UGMS by the U. S. Bureau of Mines, Public Land Statistics, 1969, U. S. Department of the Interior Bureau of Land Management, BLM Facts and Figures for Utah, 1970, and Utah Division of State lands fiscal report, July 1, 1969 to June 30, 1970.

Commodity	Value	Quantity
BEAVER COUNTY		
Gold	W[1]	(7)
Silver	$ 1,000	834,000 troy oz.
Copper	(7)	(7)
Lead	4,000	12 s. t.[2]
Zinc	2,000	7 s. t.
Pumice	W	W
Sand and gravel	311,000	313,000 s. t
Perlite	W	W
Total	$ 1,689,287	
BOX ELDER COUNTY		
Lime	W	W
Salt	W	W
Sand and gravel	$ 801,000	819,000 s. t.
Stone	1,563,000	1,460,368 s. t.
Total	$ 2,364,000	
CACHE COUNTY		
Lime	W	W
Sand and gravel	$ 171,000	134,000 s. t.
Stone	279,000	184,487 s. t.
Total	$ 450,000	
CARBON COUNTY		
Carbon dioxide	$ 5,000	64,839 t. c. f.[3]
Coal	18,372,915	3,366,926 s. t.
Natural gas	161,943	1,018 m. c. f.[4]
Sand and gravel	40,000	38,000 s. t.
Total	$ 18,579,858	
DAGGETT COUNTY		
Natural gas	$ 117,966	739 m. c. f.[5]
Petroleum	8,000	3 t. b.[5]
Sand and gravel	26,000	26,000 s. t.
Stone	66,000	34,290 s. t.
Total	$ 217,966	
DAVIS COUNTY		
Sand and gravel	$ 1,593,000	1,939,000 s. t.
Total	$ 1,593,000	
DUCHESNE COUNTY		
Natural gas	$ 43,898	278 m. c. f.[5]
Petroleum	3,874,668	1,356 t. b.[5]
Sand and gravel	349,000	459,000 s. t.
Stone	92,000	21,302 s. t.
Total	$ 4,359,566	
EMERY COUNTY		
Coal	$ 6,039,643	1,199,986 s. t.
Natural gas	68,000	429 m. c. f.
Petroleum	22,984	6 t. b.[5]
Sand and gravel	277,000	267,000 s. t.
Uranium, U_3O_8	293,000[10]	49,844 lb.
Vanadium	W	W
Total	$ 6,700,627	
GARFIELD COUNTY		
Gold	$ 57,000[9]	1,379 troy oz.
Silver	1,259,000	702,850 troy oz.
Copper	79,000	83 s. t.
Lead	2,409,000	8,087 s. t.
Zinc	3,007,000	10,299 s. t.
Petroleum	2,278,000	1,564 t. b.[5]
Sand and gravel	124,000	112,000 s. t.
Uranium, U_3O_8	3,000[10]	523 lb.
Vanadium	W	W
Total	$ 9,216,000	
GRAND COUNTY		
Natural gas	$ 880,975	5,564 m. c. f.
Petroleum	298,000	126 t. b.[5]
Potassium salts	W	W
Sand and gravel	W	W
Uranium, U_3O_8	274,000[10]	45,989 lb.
Vanadium	W	W
Total	$ 7,452,975	
IRON COUNTY		
Coal	W	3,998 s. t.
Iron ore	$ 12,552,000	1,921,000 l. t.[6]
Pumice	W	W
Sand and gravel	530,000	466,000 s. t.
Stone	(7)	44 s. t.
Total	$ 13,082,000	
JUAB COUNTY		
Gold	$ 40,000	961 troy oz.
Silver	157,000	87,924 troy oz.
Copper	27,000	28 s. t.
Lead	87,000	293 s. t.
Zinc	(7)	1 s. t.
Clays	W	W
Fluorspar	207,000	6,667 s. t.
Sand and gravel	96,000	111,000 s. t.
Stone	W	6,000 s. t.
Total	$ 1,614,000	
KANE COUNTY		
Coal	W	1,199 s. t.
Sand and gravel	$ 121,000	132,000 s. t.
Total	$ 121,000	
MILLARD COUNTY		
Sand and gravel	$ 172,000	172,000 s. t.
Stone	(7)	5 s. t.
Total	$ 172,000	

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MORGAN COUNTY			
Cement, masonry and portland		W	W
Sand and gravel		W	W
Stone		W	W
Total		W	
PIUTE COUNTY			
Gold		(9)	(9)
Silver		(9)	(9)
Copper		(9)	(9)
Lead		(9)	(9)
Zinc		(9)	(9)
Clays		W	W
Sand and gravel	$	4,000	8,000 s. t.
Uranium, U_3O_8		5,000[10]	842 lb.
Total	$	429,000	
RICH COUNTY			
Phosphate rock		W	W
Sand and gravel	$	2,000	2,000 s. t.
Total	$	2,000	
SALT LAKE COUNTY			
Gold	$	15,661,000	377,294 troy oz.
Silver		7,005,000	3,911,844 troy oz.
Copper		280,188,000	294,724 s. t.
Lead		5,850,000	19,636 s. t.
Zinc		3,679,000	12,600 s. t.
Cement, portland		W	W
Lime		W	W
Clays		W	W
Molybdenum		W	W
Salt		W	W
Sand and gravel		4,024,000	4,417,000 s. t.
Stone		W	W
Tungsten, 60 percent WO_3		6,000	3 s. t.
Total	$	316,413,000	
SAN JUAN COUNTY			
Gold		W	W
Silver		W	W
Copper	$	538,000	565 s. t.
LP gas		W	W
Natural gas		3,179,000	20,124 m. c. f.
Natural gasoline		W	W
Petroleum		36,323,000	12,887 t. b.[5]
Sand and gravel		305,000	305,000 s. t.
Uranium, U_3O_8		6,249,000[10]	1,043,143 lb.
Vanadium		W	W
Total	$	50,594,000	
SANPETE COUNTY			
Clays		W	W
Natural gas		W	34 m. c. f.
Salt		W	W
Sand and gravel	$	40,000	53,000 s. t.
Total	$	130,241	
SEVIER COUNTY			
Gold		(9)	(9)
Silver		(9)	(9)
Copper		(9)	(9)
Lead		(9)	(9)
Zinc		(9)	(9)
Clays		W	W
Coal		W	71,986 s. t.

(Sevier County continued)

Gypsum		W	W
Salt	$	481	4,439 s. t.
Sand and gravel		247,000	182,000 s. t.
Total	$	565,953	
SUMMIT COUNTY			
Gold	$	45,000	1,093 troy oz.
Silver		698,000	389,614 troy oz.
Copper		118,000	124 s. t.
Lead		1,507,000	5,061 s. t.
Zinc		1,998,000	6,841 s. t.
Clays		W	W
Coal		W	11,986 s. t.
Natural gas		79,000	502 m. c. f.
Petroleum		3,386,000	1,026 t. b.[5]
Pyrites		W	W
Sand and gravel		918,000	735,000 s. t.
Stone		466,000	112,062 s. t.
Total	$	9,215,000	
TOOELE COUNTY			
Gold	$	5,000	123 troy oz.
Silver		291,000	162,352 troy oz.
Copper		133,000	140 s. t.
Lead		636,000	2,135 s. t.
Zinc		464,000	1,590 s. t.
Clays		W	W
Lime		W	W
Magnesium chloride		W	W
Pyrites		W	W
Salt		W	W
Sand and gravel		4,214,000	6,761,000 s. t.
Stone		774,000	242,479 s. t.
Potassium salts		W	W
Total	$	6,517,000	
UINTAH COUNTY			
Gilsonite		W	W
LP gases		W	W
Natural gas	$	2,755,000	17,428 m. c. f.
Natural gasoline		W	W
Petroleum		17,960,000	6,326 t. b.[5]
Phosphate rock		W	W
Sand and gravel		306,000	326,000 s. t.
Total	$	21,021,000	
UTAH COUNTY			
Gold		(9)	(9)
Silver		(9)	(9)
Copper		(9)	(9)
Lead		(9)	(9)
Zinc		(9)	(9)
Clays		W	W
Lime		W	W
Sand and gravel	$	290,000	371,000 s. t.
Stone		W	W
Total	$	290,000	
WASATCH COUNTY			
Gold	$	2,181,000	52,531 troy oz.
Silver		1,250,000	698,149 troy oz.
Copper		984,000	1,035 s. t.
Lead		1,820,000	6,108 s. t.
Zinc		1,041,000	3,564 s. t.
Sand and gravel		15,000	10,000 s. t.
Stone		56,000	48,350 s. t.
Total	$	7,347,000	

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WASHINGTON COUNTY		
Gold	W	W
Silver	W	W
Copper	W	W
Petroleum	(7)	(7)
Sand and gravel	$ 127,000	82,000 s. t.
Total	$ 127,000	
WAYNE COUNTY		
Sand and gravel	$ 16,000	16,000 s. t.
Uranium, U_3O_8	W	W
Total	$ 16,000	
WEBER COUNTY		
Sand and gravel	$ 826,000	813,000 s. t.
Stone	18,000	4,077 s. t.
Total	$ 844,000	
Undistributed[1]		
Sand and gravel	$ 96,000	83,000 s. t.
Stone	1,120,000	468,843 s. t.
Gem stones	85,000	–
Clays	1,286,000	179,000 s. t.
Lime	3,947,000	191,000 s. t.
Undisclosed values	55,789,000	
Total	$ 62,323,000	
GRAND TOTAL	$543,446,473	

[1] W = Withheld to avoid disclosing individual company confidential data; values are included in county totals. County totals that have been withheld to avoid disclosing individual company confidential data are included with "undistributed".

[2] s. t. = short tons.

[3] t. c. f. = thousand cubic feet.

[4] m. c. f. = million cubic feet.

[5] t. b. = thousand barrels.

[6] l. t. = long tons.

(7) Less than ½ unit.

[8] Includes county values indicated by symbol "W" and gem stones that cannot be assigned to specific counties.

(9) Production of Garfield, Piute, Sevier, and Utah counties combined to avoid disclosing individual company confidential data.

[10] Value estimated, based on $5.86 per pound for sales to the Atomic Energy Commission and an assumed price of $6.10 per pound for commercial sales; includes value of U_3O_8 obtained from Utah ores processed at out-of-state mills.

Environmental Quality Concern of GSA

Many of the papers presented in early November 1970 at the annual meetings in Milwaukee of the Geological Society of America and its associated societies reflected the widespread concern with Earth's dominant species, man, and the related problems of environmental quality and mineral resources. Following are some observations made at the meetings:

¶ Successful solution of problems of geologic hazards and pollution requires special education of both geologists and the general public. We recognize the problems; now focus must be on application of procedures that reduce environmental degradation.

¶ Nature does indeed conform to the basic principles of geology. Floods and mudflows in southern California caused least damage in areas developed where local governments require combined efforts of geologists, engineers and planners.

¶ Speakers urged a curriculum to train geologists to work effectively with land-use planners. Many planners are unaware of the value of geologic reports or how to use them; many geologists neither understand the problems faced by professional planners nor are trained to compile reports for their specific needs. Few published geologic studies are prepared with the urban planner in mind.

¶ Introductory geology is rarely relevant to most students. The world is urban and populous; geology is rural and antiseptic. Urban geology offers great return for minimal investment in an area of urgent need.

¶ New concern for the environment must lead to a new kind of significance of the cost-benefit ratio. Heretofore limited to dollars and cents, we must now apply it to the *total* costs; we must find ways to apply definite values to intangible factors such as scenic worth.

¶ As for seismic activity studies, no correlation has been found between seismicity and water loading. Studies around dams, reservoirs and artificial bodies of water confirm this.

¶ Reports from the Nevada Test site, which is monitored by high-gain seismographs, state that there is a general tendency for the area of seismicity to enlarge with time. Bursts of activity have occurred weeks after an explosion. Studies indicate that natural tectonic strain energy is thus released. General feeling in the meeting seemed to be that prospect of earthquake prediction is less promising than earthquake prevention by such methods as deep explosives and water flooding, aimed at releasing strain.

Minerals activity on federal lands in Utah,
July 1, 1969, to June 30, 1970 (U. S. Bureau of Land Management)

Commodity	Mineral Permits and Licenses		Mineral Leases		Production	Receipts	
	Number	Acres	Number	Acres		Leases, Permits	Royalties
Petroleum					11,374,753 bbls		
Natural gas	1,720	2,387,166	14,263	7,588,809	26,615,574 Mcf	$8,029,724	$4,361,721
Oil and gas liquids					57,656,173 gals		
Coal	29	96,250	244	411,954	1,927,397 s.t.	466,863	334,508
Other						47,158	45,078
Potash	19	43,359	50	95,866		90,200	4,825
Phosphate	2	1,104	21	29,907		14,973	3,952
Gilsonite and bituminous sands	0	0	20	11,788			
Totals	1,770	2,527,879	14,598	8,138,324		$8,648,918	$4,750,084

Allocation of BLM receipts to state of Utah for mineral leases and permits: $3,302,484.

(more Mineral Production on page 15)

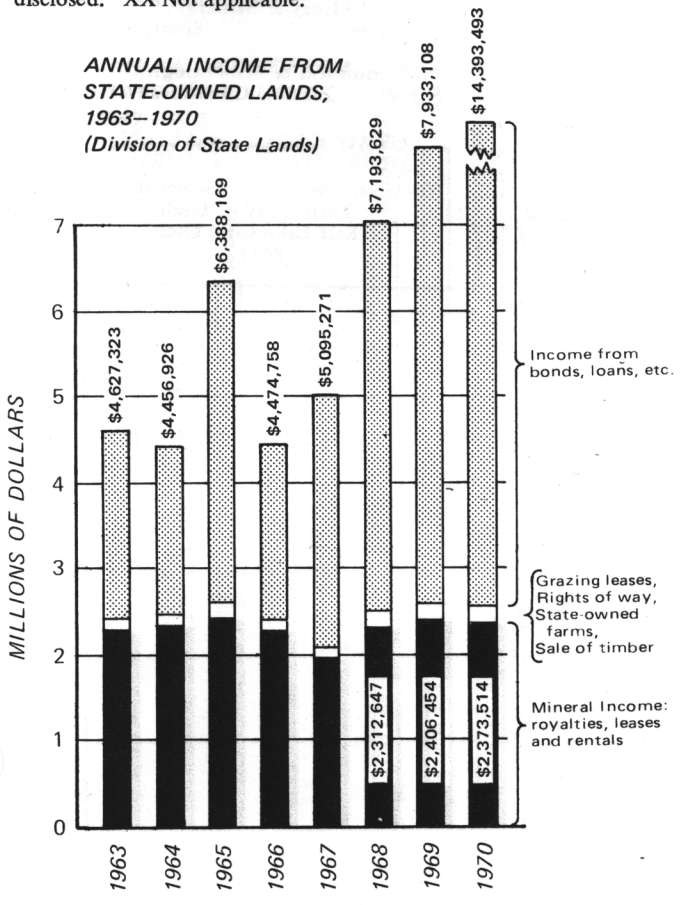
Mineral Production in Utah in 1969 and 1970.

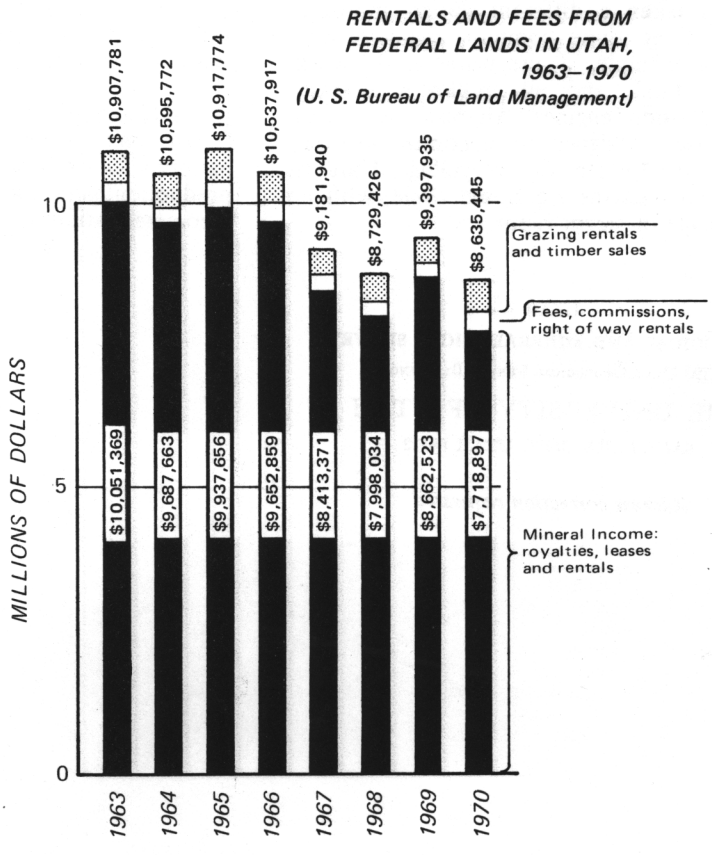
Mineral		1969 Quantity	1969 $ Value (thousands)	1970 Quantity	1970 $ Value (thousands)
Carbon dioxide (natural)	thousand cubic feet	64,839	$ 5	61,000	$ 4
Clays	thousand short tons	179	1,286	255	1,455
Coal (bituminous)	do	4,657	29,396	4,852	37,900
Copper (recoverable content of ores, etc.)	short tons	296,699	282,066	305,800	358,826
Fluorspar	do	6,667	207	19,700	596
Gem stones		NA	85	NA	85
Gold (recoverable content of ores, etc.)	troy ounces	433,385	17,990	420,000	15,070
Iron ore (usable)	thousand long tons, gross weight	1,921	12,552	1,914	12,491
Lead (recoverable content of ores, etc.)	short tons	41,332	12,313	44,900	14,126
Lime	thousand short tons	191	3,947	179	3,633
Natural gas (marketed)	million cubic feet	46,733	7,197	44,135	7,106
Petroleum (crude)	thousand 42-gallon barrels	23,295	65,320	23,500	66,975
Pumice	thousand short tons	10	21	10	21
Salt	do	481	4,439	441	3,797
Sand and gravel	do	19,151	16,042	12,600	10,200
Silver (recoverable content of ores, etc.)	thousand troy ounces	5,954	10,661	6,115	11,095
Stone	thousand short tons	2,582	4,434	1,474	2,678
Tungsten concentrate (60 percent WO_3 basis)	short tons	2[3]	4[3]	W	W
Uranium (recoverable content U_3O_8)[2]	thousand pounds	1,140	6,824	W	W
Vanadium	short tons	444	1,866	419	2,879
Zinc (recoverable content of ores, etc.)	do	34,902	10,191	39,500	12,102
Value of items that cannot be disclosed: asphalt and related bitumens, beryllium (bertrandite ore), cement, gypsum, magnesium chloride, manganiferous ore (1970), molybdenum, natural gas liquids, phosphate rock, potassium salts, sodium sulfate (1970), and value indicated by symbol W		XX	55,789	XX	68,548
TOTAL		XX	$524,653[3]	XX	$629,587

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Values estimated based on $5.88 (1969) and $5.60 (1970) per pound for sales to the Atomic Energy Commission and an assumed price of $6.35 (1969) and $6.25 (1970) per pound for commercial sales; includes values of U_3O_8 obtained from Utah ores processed at out-of-State mills.

[3] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.





Steambus Test Contracts Set

Agreement on contracts with manufacturers to provide steam-powered buses for testing in California cities was reached in June 1970. In approximately one year tests will be conducted to determine the buses, emission levels, system efficiency, reliability and operating costs.

With the addition last September of the Southern California Rapid Transit District as a participant, the Steam Bus Project has now become a statewide effort.

Actual construction of the steam systems began last June. The first demonstration vehicle should be ready for testing by June 1971. If initial tests proceed without major difficulties, a demonstration vehicle may be operating on East Bay, San Francisco or Los Angeles streets by September 1971.

This work is proceeding under a grant from the Urban Mass Transportation Administration, U. S. Department of Transportation, to the California Assembly Rules Committee. The grant totals $1,202,036 in federal funds.

While each steam system supplier has taken a different design approach, all three share common characteristics. For example, all use water as the working fluid, and all employ multi-stage expansion engines. All buses have condensers designed to maximize recovery of the water for recycling. Thus all steam systems are closed cycle, with no escape of steam vapor.

Guidelines For Mineral Development Needed

The fast-developing confrontation between agencies involved in fulfilling the mineral resource needs of our society and those who desire to maintain our environment at acceptable levels has drawn the attention of the Division of Earth Sciences of the National Academy of Sciences-National Academy of Engineering-National Research Council.

The Division proposes a "study concerned with the need to establish quidelines to assure an acceptable balance between preservation of the quality of man's environment and provision for his needs for nonrenewable mineral resources."

Five kinds of actions, according to the Division, are needed:

(1) Determination of natural base-lines from which to measure humanly generated pollution.

(2) Determination of the effects of the various pollutants on the biozone.

(3) Estimation of year-by-year needs for the various mineral materials.

(4) Analysis of scientific, engineering and educational programs needed to meet anticipated demands.

(5) Establishment of guidelines setting forth environmentally acceptable methods for exploration, development, production, and use of minerals, and recommendation of methods for obtaining acceptance of guidelines.

The Division of Earth Sciences proposes to devote its major effort toward item 5 above. It is anticipated that the other four items are being or will be covered by agencies, some of massive proportions. It is to be hoped that the total picture will be assembled and evaluated by the Division in an authoritative factual document to which all segments of our society can refer.

Kaiparowits Plateau

POWER PLANT POSTPONED

The state of Utah extended for five years its agreements with developers of the Kaiparowits Plateau power plant to give them more time to make further studies and to reach a final decision on plant construction.

QUARTERLY REVIEW

State of Utah .....*Calvin L. Rampton Governor*
University of Utah .....*James C. Fletcher President*
College of Mines & Mineral Industries .....*George R. Hill Dean*
Utah Geological & Mineralogical Survey .....*William P. Hewitt Director*

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Gentlemen:

This is our yearly request for help from you. Inquiries regarding Utah geology often involve areas where there is no published geologic coverage, but on which there has been geologic field work. Therefore, the Utah Geological and Mineralogical Survey hereby solicits your cooperation for our open file listing of those areas being studied by professors and students or agencies. The Survey requests that you circulate this form among your staff and graduate students so it may be filled in and returned. Information supplied by respondents will be published in the *Quarterly Review* and should be submitted not later than March 31.

Your general knowledge of studies being conducted by other organizations or universities is also requested.

Some of the information solicited may be contingent on future decisions. Please do not withhold that which is available pending more definite plans. Our compilation must be timely if it is to be meaningful.

Where possible, please indicate on the map on the other side of this page the areas covered or to be covered.

Yours truly,

W. P. Hewitt

William P. Hewitt, Director
Utah Geological and Mineralogical Survey

Cut along dotted line and mail

Organization _____

Name of chief investigator _____

Address _____

Subject of thesis _____ or study _____

Geographic area _____

Location by township _____ Range _____

Latitude _____ Longitude _____

(Please also note location on reverse side on map)

Scope and class: (i.e., detail, reconnaissance, photo interpretation with or without field checking, etc.)

Pertinent information: (i.e., special techniques, methods, map scales, cooperating agencies, commodities, etc.)

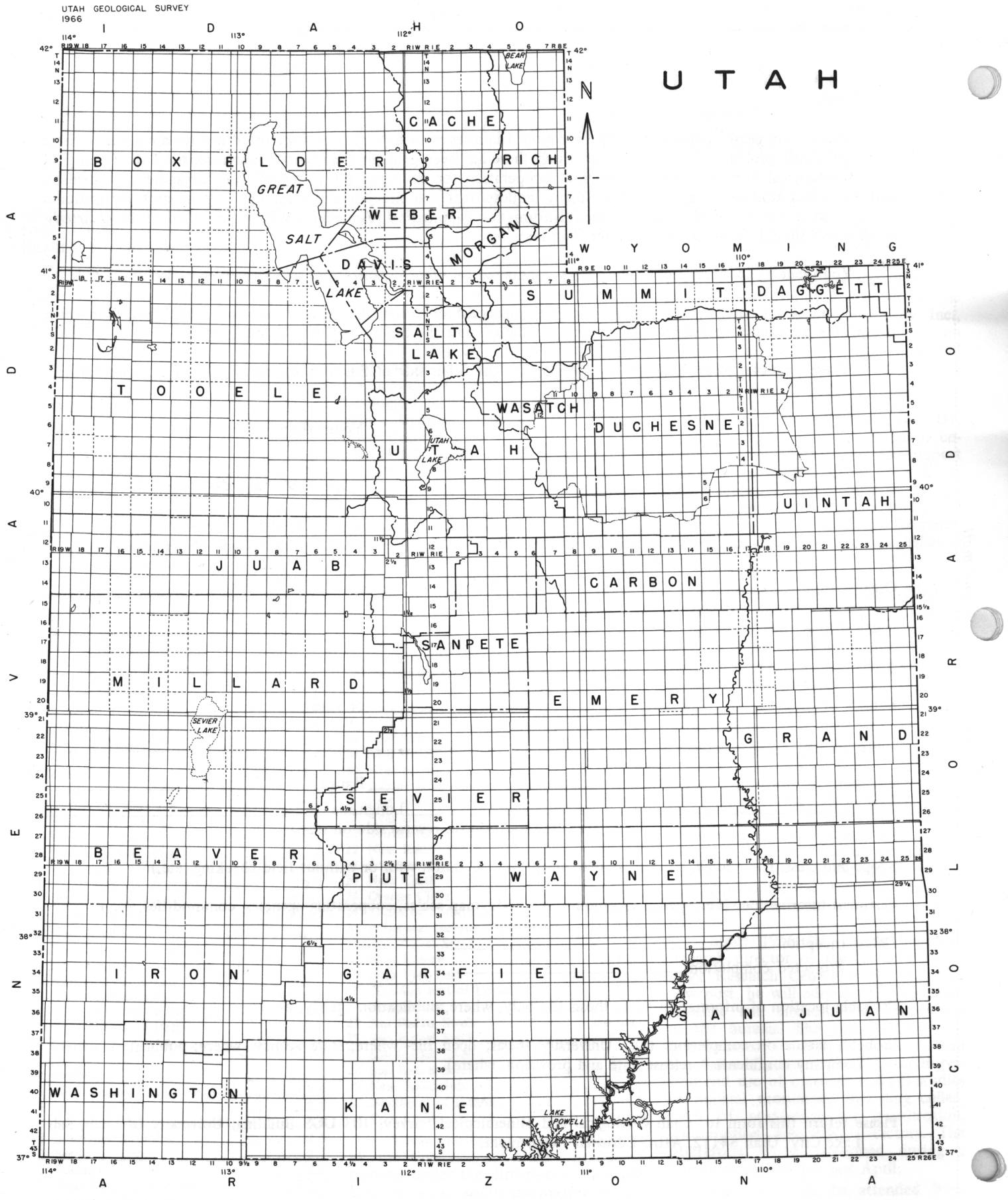
Dates: Inception _____

Projected completion _____

Probable location of information: (i.e., thesis file only, where, publication agency, etc.)

Probable status on completion: (i.e., University thesis; open file–where; state agency–where; publication–where; company confidential–release date and provision, where)

Please return this form to: Utah Geological and Mineralogical Survey, 103 UGS Building, University of Utah, Salt Lake City, Utah 84112, Attn: Editorial Department.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